The Automobile Simplified

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AN intimate talk on the working units of the automobile discussed in such a way that the layman can easily understand them.

If in reading these articles, as they appear in The World each Sunday, there is anything not clear to you, ask Mr. Guerrlich about it. An answer will be published on the completion of the articles on the section of the automobile under discussion.

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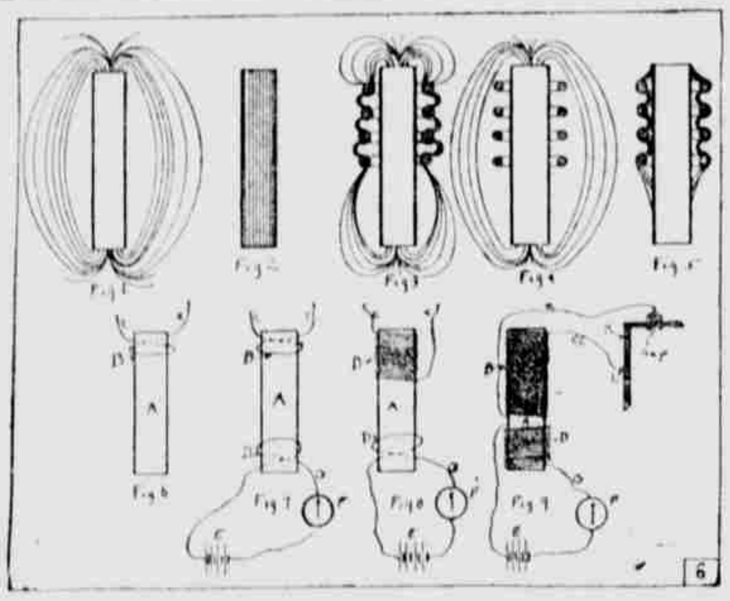

6

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LESSON NO. 6

Induction Coil.

In a previous lesson, we learned that we required a very high voltage in order that the current could jump across the spark plug points, while it was impractical to carry enough batteries or large enough generator to give us this high voltage. We will now see how we can transform a low voltage current into one of high voltage. This brings us to the study of the induction coil.

As every ignition system has an induction coil, it is extremely important for the reader to clearly understand it. While it is a difficult thing to understand, I believe, if the student will carefully study each one of the actions given below, that he will be able to understand the various systems. He will, however, have to rely on his imagination to some extent, and take for granted that each of the actions given is true, even though he does not quite see why or how they take place.

If an insulated wire is coiled about a piece of soft iron, or bundle of soft iron wires, very much the same as thread is coiled on a spool, and an electric current made to flow through this wire, the piece of soft iron, which we might name the core, will become a magnet and will draw to it comparatively heavy pieces of steel.

If the flow of the current is stopped, the core will cease to be a magnet.

The above is a property of electricity and magnetism which, while difficult to explain, is used in a great many electrical devices notably the electric bell, the telegraph, electric lifting magnets, etc.

As a soft iron core becomes a magnet, as stated above, when a current flows through the coil, so also can a current be made to flow through the wire of the coil, if the core is made to be a magnet, or in other words, is magnetized.

This action, you will note, is simply the reverse action of the one explained above.

Let us see what affects the strength of the magnetism of the core.

4—If we had but one turn of wire about the core, when a current of a certain voltage and a certain amperage is sent through the wire, the core will be magnetized to a certain amount; if we had two turns, it will be twice the amount and if three turns three times the amount. Thus the strength of the magetism is directly dependent on the number of turns of wire and the amount of current flowing through the wire.

Now let us see what will affect the strength of the current which will flow through the wire in the second case, that is, where it is made to flow by the magnetizing of the core.

5—If there be but one turn of wire around this core when it is magnetized to a certain extent, a current having a certain amount of voltage and amperage will flow, while if there be but two turns about the core, each turn will have the same voltage or pressure and the two pressing together will give twice the voltage and so likewise three will give us three times the voltage and ten thousand turns ten thousand times the voltage of one turn.

6—The amount of current made to flow will, however, decrease as the number of turns is increased, or in other words, the amperes, when there are ten thousand turns of wire, will be but one ten thousandth or what it will be with one turn of wire.

There is one difference between the action when the core becomes magnetized by current passing through the wire and the reverse case, that is, where current is made to flow through the wire due to the magnetizing of the core, which is this:

7—In the case of the core being magnetized by a current flowing through the coil, the core will become a magnet the moment the current flows and will remain a magnet just as long as it does flow, losing its magnetism only when the current stops flowing or is interrupted.

8—In the second case, however, that is, where the current is made to flow through the wire due to the magnetizing of the core, there will be a shot of current the instant the core is magnetized, or the instant it is demagnetized, but the current will not flow in a constant stream, it stopping after the instant of magnetism, even though the core remain a magnet.

If the core is suddenly demagnetized there will again be a shot of current through the wire, of the same voltage as when the core is magnetized, but it will flow in the opposite direction.

I am going to give you here the way my own imagination lets me picture this action in my mind's eye.

First, I must tell you of a simple experiment. If we laid a magnet on a table and put a piece of paper on this magnet and then sprinkled some iron filings on the paper these filings upon tapping the paper would form themselves in definite lines, as shown in Fig. 1. Thus proving that there are certain lines of force running from the one pole to the other and taking the course shown by the filings. Electricians call these magnetic lines of force. Of these there will be millions, depending on the strength of the magnet.

Let us imagine that when the soft iron core is not a magnet these lines are in the iron itself, as shown in Fig. 2, and that when the core is magnetized they are sort of blown out from the core, much the same as a balloon acts when being blown up. If their ends be fastened to ends of the core the result would be that these lines would then bulge out from the side of the core until they took the form of Fig. 1.

Now suppose a wire were wrapped around the core. Then these wires would tend to prevent this bulging out and the lines would then first take the form shown in Fig. 3, until the strain became so great that they snapped. In snapping the lines would coil or whip lash about the wires. There being, however, millions of these lines, more of them will have coiled on the wire than can be held on it and they will therefore, be forced to travel along the wire. Thus the magnetic lines will have been converted into electric lines of electricity.

Let us assume that after the lines have snapped about the wires they succeed in joining their ends and thus take the form shown in Fig. 4.

Now, when the core is demagnetized let us suppose that the lines contract and again try to take the form shown in Fig. 3. As they meet the wires while contracting they will first take the form of Fig. 5, then snap about the wires and thus send a current of electricity through the wires, much the same as in the previous case, but in the opposite direction.

To review the above, we see that if a soft iron core have a coil of wire wound about it, it will be a magnet, while an electric current is flowing through the wire and that this action will work in the opposite direction (that is, if a core be suddenly magnetized or demagnetized a current will flow in the wire coiled about it); and that the voltage of this current will be dependent on the number of turns of wire.

Let us now see how we can use the above actions to transform the low voltage current (to give which we can conveniently carry sufficient batteries or large enough generator) into the high voltage current which we must have in order that it can burst or jump across the air gap of the spark plugs.

Reffering to Fig. 6, this shows a core (a) with a single coil of wire (B) wound about one end of it. From the above, (3) and (5), we learn that if we could suddenly magnetize the core (a), a shot of current would flow through the wire C. How can we magnetize this core? Why, by simply winding about the other end another coil of wire and letting a current pass through this from a battery or other source and having a switch in the circut for controlling the flow of the current.

Figure 7 shows that we now have, (a) being the core (b) the coil in which we want to make a current flow, (d) the coil in which a current can flow from the battery (E), thus magnetizing (A), and (F) the switch.

Repeating, if we were to suddenly close the switch, a current would flow in the coil (D), thus magnetizing the core (a), and because of this magnetization there will be a shot of current in the coil (B) and wire (C). Upon suddenly opening the switch, thus interrupting the current in the coil (D), the core (a) will be demagnetized and there will be a shot of current in the coil (B) and wire (C) in the opposite direction to that which flowed when the switch was closed.

The strength of the magnetism of the core will depend upon the voltage and amperage of the current in the coil (D), and it is natural to believe that this strength of magnetism will cause a current to flow in (C) of the same voltage as that in (G). Now from 6 we learn that if the coil (B) had two turns of wire each turn would have the same voltage and both of these voltages in (C) will be twice that of (G), while if there were three turns it would be three times as great and if there were a thousand turns it would be a thousand times as great. Thus, if the coil were now as shown in Fig. 8 and we suddenly closed the switch (F), there would be shots of current in (C) of one thousand times the voltage of that in (G). Here we have what we are after, a means of transforming the low voltage current of our battery into one of high voltage.

For various reasons a single turn is never used in practice, the coil from the battery having about one hundred turns, while that to the plugs has about a thousand times as many turns, the wire, however, being extremely fine. For room's sake, it is also the practice to place the one coil above or about the other.

Fig. 9 shows what we now have, but with the coils still side by side and with the spark plug connected to the high voltage wire. The action will be this: If the switch (F) were suddenly closed or opened the core will be suddenly magnetized and there will be a shot of very high voltage current through the wire (c), which will travel to spark plug, then jump across the gap and return through the metal of the engine (K), or "ground" to the point (L), where it will be collected by the wire (CC).

Primary and Secondary.

As the low voltage current from the battery or other source is the first current, it is called the primary, while the high tension (or voltage) current, being the second, it is called the secondary. The wires, switch, coil, etc., through which the primary current passes are in the primary circuit, while those through which the secondary passes are in the secondary circuit.

Note that the primary has a comparatively low voltage and high amperage, while the secondary has a high voltage and low amperage.

Engineers say that the current is induced from one coil into the other, so that the coil is called an induction coil. It is also sometimes called a transformer coil.

In our next lesson we will see how the induction coil is used in a complete system.

Would Help to Find Him.

A woman entered the police station in a Massachusetts town and in a confused, agitated manner implored the officer in charge to have a nearby river dragged.

"My husband has been threatening for some time to drown himself," she explained, "and he's been missing now for three days."

"Anything peculiar about him by which he could be recognized?" the officer questioned, preparing to fill out a description blank.

The woman meditated thoughtfully for a few moments, then her face brightened.

"Why, yes, he's deaf."

Sammy Turned Over.

It is said that a gravestone bears this inscription: "Here lies the body of Sammy Holden, who died suddenly and unexpectedly by being kicked to death by a cow. Well done, good and faithful servant!"